BEATY, ROGER E., M.A. Metaphorically Speaking: The Role of Cognitive Abilities in the Production of Figurative Language. (2012)
Directed by Dr. Paul J. Silvia. 80 pp.

Figurative language is one of the most common expressions of creative behavior in everyday life. However, the cognitive mechanisms behind figures of speech such as metaphor remain largely unexplained. Recent evidence suggests fluid and executive abilities are important to the generation of conventional and creative metaphors. The present study investigated whether several factors of the Cattell-Horn-Carroll (CHC) model of intelligence contribute to generating these different types of metaphors. Specifically, the roles of fluid intelligence (Gf), crystallized knowledge (Gc), and general retrieval ability (Gr) were explored. Participants completed a series of intelligence tests and were asked to produce conventional and creative metaphors. Structural equation modeling was used to assess the contribution of the different factors of intelligence to metaphor production. Model results for creative metaphor showed large effects of Gf ($\beta = .45$) and Gr ($\beta = .52$), whereas Gc had a moderate effect on conventional metaphor production ($\beta = .30$). The present research extends the traditional study of divergent thinking to an area important to everyday communication, and advances a testable framework of creative cognition based on the CHC model of intelligence.

METAPHORICALLY SPEAKING: THE ROLE OF COGNITIVE ABILITIES IN THE PRODUCTION OF FIGURATIVE LANGUAGE

by

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A Thesis Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Greensboro
2012

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May 17, 2012

Date of Acceptance by Committee

May 17, 2012

Date of Final Oral Examination

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CHAPTER I

INTRODUCTION

Figurative language is perhaps the most common expression of creativity in everyday life (Carter, 2004). People often use figures of speech like metaphor to describe a vast array of emotions and experiences. Although figurative language pervades human dialogue, our understanding of how people come up with these types of expressions is quite limited. Psycholinguistic research has produced a wealth of knowledge on metaphor comprehension (e.g., Gibbs, 1994; Glucksberg, 2001; Kintsch, 2000; Lakoff & Johnson, 1980), but we are only now starting to understand how the mind creates figurative language. Recent investigations have begun to shed light on the underlying cognitive processes involved in metaphor production (Chiappe & Chiappe, 2007; De Barros, Primi, Miguel, Almeida, & Oliveira, 2010; Pierce & Chiappe, 2009; Silvia & Beaty, 2012).

Nevertheless, all metaphors are not created equal – they vary in terms of novelty and familiarity. In the present study, we were interested in examining the cognitive processes that cause these different types of figurative language. Conventional metaphors are straightforward, often cliché or idiomatic expressions. Metaphors are typically defined by aptness, or the extent to which the structure represents a comprehensible and appropriate comparison between a topic and a characteristic exemplar (Tourangeau & Sternberg, 1982). For example, the conventional description "life is a journey" entails a 1-to-1 comparison, one that is familiar and easily comprehended. There must be some conceptual distance between topic and exemplar; otherwise the comparative statement is literal and not figurative.

In contrast, creative metaphors are distinctly unique expressions of language. Researchers often discuss conventional metaphors in terms of aptness or appropriateness (e.g., Gibbs, 1994; Tourangeau & Sternberg, 1982) and assess the conceptual agreement between the topic and vehicle in a figurative statement (Chiappe & Chiappe, 2007; Pierce & Chiappe, 2009). Creative metaphors, on the other hand, are frequently used in conversation to describe an emotional experience (Carter, 2004), developed to express imagery in literature (Plotnik, 2004), and employed as a symbolic tool in several artistic traditions (Kennedy, 2008). They are unique in the sense that both the creator of the expression and their audience are unfamiliar with the descriptive phrase. In our previous study (Silvia & Beaty, 2012), we adopted criteria from subjective scoring methods of divergent thinking responses (Nusbaum & Silvia, 2011; Silvia et al., 2008) to empirically assess the quality of creative metaphors. Responses were considered creative to the degree that they represented a remote, clever, and unique expression.

The structure and function of metaphor have long been considered by researchers interested in the comprehension of figurative language (Glucksberg, 2001; Lakoff & Johnson, 1980), but an empirical approach to metaphor production remains largely absent from the literature. The present research examined the contribution of several cognitive abilities from the Cattell-Horn-Carroll (CHC) model of intelligence (Carroll, 1993) to the generation of conventional and creative metaphors. Recent evidence demonstrates the strong contribution of fluid intelligence to the generation of creative metaphors (Silvia & Beaty, 2012), but it remains unclear how other aspects of intelligence influence both creative and conventional metaphor. This study thus explores how three CHC abilities – fluid intelligence (Gf), crystallized intelligence (Gc), and broad retrieval ability (Gr) – influence how we construct figurative language.

The Property Attribution Model

While there are several definitions of metaphor, one prominent description categorizes it as a higher-order term that includes other structures like similes and analogies (Barnden, 2010; Grady, 2007). Metaphors function as a descriptive mechanism of communication; that is, they describe a specific aspect of a given topic by relating it to a conceptually similar exemplar. Exemplars are often referred to as vehicles, and they embody some level of abstract relation to a referent concept (i.e., the topic). The study of metaphor comprehension has been of interest to cognitive linguists for several decades, and a large body of research has been dedicated to understanding metaphoric structure and function (e.g., Gibbs, 1994; Glucksberg, McGlone, & Manfredi, 1997; Lakoff & Johnson, 1980). Nevertheless, an empirical understanding of how the mind *produces* figurative language remains elusive.

The property attribution model of metaphor comprehension provides a useful framework for conceptualizing metaphor production. According to this model, composing a metaphor involves making an abstract link between a topic and a vehicle by relating similar characteristics (Glucksberg, 2001). Shared conceptual knowledge between the topic and vehicle must be identified for a metaphor to be comprehensible (Glucksberg et al., 1997). While people search semantic memory for an appropriate vehicle, a superordinate attributive category maintains some characteristics of the topic that can be used to relate to the vehicle. For example, if one were to consider a metaphor for "music," an attributive category – "something that is healing" – guides the search process en route to an appropriate vehicle ("medicine").

Several aspects of Glucksberg's (2001) property attribution model can be adopted to conceptualize the cognitive mechanics of metaphor generation. First, the formation and maintenance of a higher-order attributive category is analogous to Carroll's (1993) concept of broad retrieval ability (Gr). According to Carroll and his research group, Gr represents the

capacity to fluently extract knowledge from long-term memory (Cattell, 1978; Horn, 1988). Tasks developed to assess retrieval ability typically require people to generate members from a given category based on a presented cue (e.g., "list synonyms for the word *good*"). Considered in the context of Glucksberg's model, one can see an apparent parallel between attributive categories and broad retrieval ability: searching memory for a candidate vehicle to attribute to a specific topic seems much like the selective retrieval processes associated with Gr.

Furthermore, exercising top-down oversight of the metaphor generation process has been shown to recruit executive abilities associated with fluid intelligence (Gf; Silvia & Beaty, 2012). Previous research demonstrates Gf's considerable association with working memory capacity (Kane et al., 2004), and implicates this ability in other controlled processes such as directing attention during complex cognitive tasks (Heitz, Unsworth, & Engle, 2005) and managing interference from task-irrelevant information (Unsworth, 2010). Central to the attribution model described by Glucksberg (2001) is the process of relating two otherwise semantically unrelated concepts (e.g., *lawyers* and *sharks*). One must prevent the literal or adjectival information closely linked to the topic and vehicle from interfering with the goal of making a figurative connection (e.g., some lawyers can be predatory, but they do not share the physical characteristics of sharks). We would thus expect fluid and executive abilities to facilitate the search process by maintaining the task goal in mind and inhibiting inapt associates that compete for activation in memory.

Several researchers characterize creative cognition as a type of novel problem solving (Finke, Ward, & Smith, 1992; Kozbelt, 2008; Lubart, 2000; Weisberg, 2006). In terms of metaphor generation, for example, we must solve the "problem" of portraying an experience within situational and semantic constraints. Likewise, fluid intelligence is broadly understood as the ability to reason in new contexts (Heitz, Unsworth, & Engle, 2005), and reasoning assessments typically require the execution of higher-order processes such as discernment, rule

discovery, and pattern detection (Carroll, 1993; McGrew, 2005). We would therefore expect similar evaluative mechanisms to facilitate metaphor production by defining the problem space and determining whether a candidate vehicle satisfies specific abstract, semantic criteria. Taken together, fluid and executive abilities should function to maintain sustained attention, inhibit task-irrelevant information, and provide oversight throughout the process of solving an open-ended problem.

Conventional Metaphor Production

An interest in metaphor generation has reemerged in the past decade, with several researchers attempting to identify the underlying cognitive processes involved (Chiappe & Chiappe, 2007; De Barros et al., 2010; Pierce & Chiappe, 2009; Silvia & Beaty, 2012). In a series of experiments, Chiappe and Chiappe (2007) administered measures of executive function and a series of metaphor tasks. In Experiment 1, participants completed a working memory task (Listening Span), a measure of inhibitory control (Stroop task), and a metaphor comprehension task designed by the authors (see Chiappe & Chiappe, 2007). Participants were split into high and low working memory span based on performance on the Listening Span task. Analysis of variance indicated that high-spans produced better metaphor interpretations – scored for quality on a three-point scale by two raters – and did so at a faster rate than low-spans. Intrusion errors on the Stroop task were negatively correlated with the quality of metaphor interpretations and the length of time it took participants to generate these interpretations.

The second experiment assessed metaphor generation with a fill-in-the-blank completion task. For the metaphor task, participants had 15 minutes to complete 24 figurative statements, and they were given property descriptions to relate to each vehicle (e.g., "Some jobs are _____"; Property: something that is confining and constraining, and can make you feel like you're just putting in time). Two raters scored responses on a six-point scale for aptness. Several executive

tasks were administered, including measures of working memory (Listening Span), verbal fluency (generating first names, foods & drinks, and animals), and vocabulary knowledge (Peabody Picture Vocabulary Test; PPVT). Performance on the PPVT explained most of the variance in metaphor quality (R^2= .17), while Listening Span scores explained a smaller yet significant portion of variance (R^2= 0.10). Commonality analysis was used to determine distinct contributions of variance from these independent measures. The unique proportion of variance contributed by Listening Span reduced to 2.9%, with the remaining variance attributed to a shared contribution along with vocabulary knowledge.

Similar to Experiment 2, the third experiment assessed the role of working memory and vocabulary knowledge to the composition of conventional metaphors. Working memory was measured with Listening Span, Digit Span Forward, and Digit Span Reverse. Participants completed the PPVT, verbal fluency tasks, the metaphor generation task, and the Magazine Recognition Questionnaire – a measure of familiarity with printed media – to assess one component of general knowledge. As a set, commonality analysis revealed that PPVT and Listening Span scores explained 31.3% in metaphor quality, of which a majority (26.6%) was contributed by the PPVT. A second commonality analysis including Print Exposure and Listening Span showed a similar pattern (R^2 = 28.6), with Listening Span explaining 9.1% of unique variance. Digit Span tasks were not included in the reported analysis, since performance on these tasks was weakly correlated with metaphor quality. Taken together, the authors interpreted the results from these three experiments as an indication that crystallized knowledge and executive abilities influence the process of metaphor production individually.

Creative Metaphor Production

Investigations of conventional metaphor demonstrate how people construct simple figurative statements that are straight-forward and easily interpreted. They have been limited to

analyzing singular, discrete vehicles that are produced in response to fill-in-the-blank tests (e.g., Chiappe & Chiappe, 2007; Christensen & Guilford, 1963; De Barros et al., 2010; Taylor, 1947). In some cases, metaphor completion tasks have included additional constraints on cognition by essentially providing a definition of the to-be-produced vehicle (e.g., Chiappe & Chiappe, 2007; Pierce & Chiappe, 2009). While these studies contribute to a greater understanding of conventional thinking, they have several limitations for studying creative cognition.

Recent evidence suggests that fluid intelligence is essential to the creative thought process (Beaty & Silvia, in press; Nusbaum & Silvia, 2011; Silvia & Beaty, 2012; Vartanian, Martindale, & Kwiatkowski, 2003). Several executive mechanisms have been shown to facilitate individual differences in creative thinking, such as controlling attention during idea generation (Vartanian, 2009; Zabelina & Robinson, 2010), implementing effective cognitive search strategies (Gilhooly et al., 2007; Nusbaum & Silvia, 2011), and switching between semantic categories in memory (Nusbaum & Silvia, 2011). Considering the substantial contribution of fluid and executive abilities to domain-general creative thinking, one might expect these mechanisms to support similar types of cognition. Silvia and Beaty (2012) examined the contribution of fluid intelligence to creative metaphor quality. Participants were presented with two different prompts, and asked to describe past emotional experiences using a metaphor. The first prompt asked people to "think of the most boring high-school or college class that you've ever had. What was it like to sit through?" For the next prompt, participants were asked to "think about the most disgusting thing you ever ate or drank. What was it like to eat or drink it?" Responses were scored by three raters on a five-point scale using subjective scoring (Silvia et al., 2008). Six measures of inductive reasoning – primarily nonverbal and visual-spatial – were administered to assess fluid intelligence. Participants also completed the Five Factor Inventory, which measures the Big Five factors of personality (McCrae & Costa, 1997). Structural equation models revealed

a large effect of fluid intelligence in predicting the creative quality of metaphors (standardized β = .49), and this effect remained large when personality was added to the model. Together, personality and fluid intelligence explained 35% of the variance in creative metaphor quality.

The creative metaphor task differs from the task used in conventional metaphor research in several ways. First, the fill-in-the-blank format is typically uniform for all items presented during a trial (e.g., Some tempers are ____) and is highly constraining on task performance. In Chiappe and Chiappe (2007), for example, participants were given a property of the topic to assist the vehicle generation process (e.g., Slowly build up and then suddenly explode). This procedure provides a very narrow range of possible vehicle choices, and it essentially guides participants to an appropriate response with a definition. Another fundamental difference is the way in which task instructions and goals are presented: in our task, we explicitly ask people to be creative and to come up with a metaphor that is clever, humorous, original, compelling, or interesting. We provide examples of creative metaphors using various structures (i.e., simile, metaphor, and compound-metaphor). The open-ended design of the prompt allows for a much more elaborate response than the simple, fixed-structure of the figurative statements task used in conventional metaphor studies. The biggest difference between creative and conventional metaphor is that there's no "right" answer for creative metaphors: the goal is to come up with something entirely original. Conventional metaphor tasks, on the other hand, suggest an appropriate answer by placing constraints on potential responses (e.g., providing an attributive property; Chiappe & Chiappe, 2007; Pierce & Chiappe, 2009).

The Present Research

In the present study, we explored the contribution of cognitive abilities to the generation of creative and conventional metaphors. Our previous study (Silvia & Beaty, 2012) demonstrated that fluid intelligence strongly predicts the creative quality of metaphors. One aim of the present

research was to extend this finding. Studies of conventional metaphor suggest that executive abilities like working memory contribute to the generation of apt metaphors (Chiappe & Chiappe, 2007; Pierce & Chiappe, 2009). Are executive abilities equally as important for generating both creative and conventional metaphors? Since working memory and fluid intelligence are closely related constructs (Kane et al, 2004; Süß, Oberauer, Wittman, Wilhelm, & Schulze, 2002), we examined the contribution of fluid intelligence to both creative and conventional metaphors.

Another primary goal of this project was to explore how different cognitive abilities contribute to conventional and creative metaphor. Specifically, we were interested in testing aspects of the Cattell-Horn-Carroll model of intelligence (Carroll, 1993; McGrew, 2005). Past research has shown that fluid intelligence (Gf) is broadly important to divergent thinking (Nusbaum & Silvia, 2011) and creative metaphor (Silvia & Beaty, 2012). Considering the results from the conventional metaphor literature (e.g., Chiappe & Chiappe, 2007; De Barros et al., 2010), one would expect Gf to be important for generating apt metaphors as well. In the present research, we examined the contribution of Gf to figurative language with the goal of determining its relative importance to both types of metaphor.

We were also interested in examining the degree to which general knowledge influences metaphor production. Figurative statements involve vocabulary and other knowledge about the world, and individuals certainly vary in terms of acquired information (Kan, Kievit, Dolan, & van der Mass, 2011). To what extent does acquired knowledge contribute to creative and conventional thinking? Carroll (1993) referred to this acquired knowledge as crystallized intelligence (Gc), a higher-order factor that "develops through the investment of general intelligence into learning through education and experience" (p. 599).

Furthermore, past research indicates that broad retrieval ability (Gr) – or the capacity to fluently recall concepts from long-term memory (Cattell, 1978) – supports the creative thought

process (Gilhooly et al., 2007; Nusbaum & Silvia, 2011). Taken in the context of the present study, the ability to retrieve knowledge from memory in an efficient and fluent manner should play an important role as well. More specifically, the generation of retrieval cues seems to be a key aspect of the selective search process. The notion that coming up with a metaphor engages selective retrieval mechanisms fits particularly well with the property attribution model of Glucksberg et al. (1997). That is, creating and deploying a super-ordinate attributive category – one that functions to guide the semantic search for appropriate descriptive vehicles – greatly resembles Carroll's (1993) conceptualization of Gr.

In this study, participants completed several assessments that measure three factors of the CHC model of intelligence: fluid intelligence, crystallized intelligence, and broad retrieval ability. We administered the conventional metaphor task of Chiappe and Chiappe (2007) as well as the creative metaphor task used in our prior study. Considering the property attribution model of Glucksberg (2001) as a framework for metaphor generation, several executive processes should be important. For example, maintaining an attributive category in mind while searching semantic memory should recruit working memory. Managing interference from inapt, obvious, and adjectival information during the metaphor generation process should also require executive resources.

Coming up with creative metaphors seems to be a challenging task, as evidenced by the tendency for more intelligent people to do better in our prior study. In light of the results from the conventional metaphor generation literature (e.g., Chiappe & Chiappe, 2007; De Barros et al., 2010; Taylor, 1947), we expected fluid intelligence to predict outcomes on the Chiappe metaphor tasks to some extent as well. However, coming up with an original, creative metaphor should be more taxing on executive resources, more so than simply completing a metaphoric statement with an appropriate vehicle term. Chiappe and Chiappe (2007) found rather weak effects for working

memory, compared to what was explained by performance on their vocabulary knowledge test. This suggests that conventional metaphor might tap crystallized knowledge more so than fluid abilities. In the present study, we thus expected fluid intelligence to influence creative metaphor more so than conventional metaphor.

CHAPTER II

METHOD

Participants

The sample was comprised of 222 undergraduate students from the University of North Carolina at Greensboro (156 women, 66 men). Participation was voluntary, and students received credit towards a research option in a psychology class for their involvement in the study. Students who indicated that English was not their primary language were excluded from analysis due to the linguistic nature of several tasks (n = 18). Multivariate outlier tests revealed one participant's data to exert extreme influence on the overall data set, so we excluded this participant from the final analysis. A closer look at the raw data file supported the outlier tests: this participant scored very highly on two of the Gf tasks and received a score of zero on another. In addition, data from participants who exhibited disengagement with the study were withheld from the analysis (n = 12). Exclusion criteria included finishing the study in less than 30 minutes, blindly clicking through tasks (as evidenced by experimenter observation notes and data analysis), frequently text-messaging, and holding conversation with other participants. The final sample consisted of 191 students (135 women, 56 men). The self-identified ethnic composition of the final sample was 57% European-American, 29% African American, 5% Hispanic/Latino, 4% Native American, 3% Asian American, and 3% undeclared.

Procedure

The study was carried out in a group setting, with the number of participants ranging from 1-8 per session. Students filled out consent forms and were briefed on the study procedure by an experimenter. Following informed consent, students completed metaphor tasks, several

cognitive tasks, and some personality questionnaires. MediaLab v2010 software was used to administer all measures in the study.

Metaphor Tasks

Conventional metaphor generation task. The metaphor task from Chiappe and Chiappe (2007) was used to assess individual differences in conventional metaphor generation. During the planning stage of the study, I contacted Dr. Chiappe with procedural questions regarding the metaphor task. Dr. Chiappe kindly forwarded electronic versions of the task materials. Twenty-four metaphor prompts were selected from the list of items. Task instructions – including metaphor examples and explanations – were taken verbatim from his test manuals and presented to participants in the present study (see Appendix C for items and instructions).

Several figurative statements provided examples during the instructions phase, along with accompanying explanations of their structure. Each item presented a topic and property description followed by a fill-in-the-blank metaphoric statement (e.g., "Come up with a metaphor that conveys that some jobs are confining and constraining, and make you feel like you are just putting in time"; "Some jobs are _____"). Participants were asked to complete each statement with a vehicle that appropriately related to the topic (e.g., "jails"). If they were unable to think of a vehicle, they were instructed to type "I don't know" into the response dialogue box. Students had fifteen minutes to complete the 24 metaphors. Following the procedure of Chiappe and Chiappe (2007), two raters scored the vehicles for aptness using a six-point scale (from *0* to *5*). Highly apt responses successfully attributed the vehicle to the topic vis-à-vis the specified property, and received a score of 5. Instances where participants could not think of an appropriate vehicle received a score of zero. The remainder of the scale (i.e., 1 – 4) was applied to vehicular responses that related to the topic to varying degrees of aptness and abstractness. Raters were

blind to each other's scores, as well as the participant identity of all individual metaphor responses. For each rater, the 24 items were averaged to get a continuous score.

Creative metaphor generation task. Following the conventional metaphor task, participants were asked to describe two past experiences with a metaphor. The aim of this task was to assess creative thinking and participants' ability to come up with an uncommon response. Instructions included definitions and examples of different types of metaphors (e.g., simile, metaphor, and compound metaphor). The experimenter informed students that they could work on the task for as long as they'd like. Following the instructions phase, participants read the first of two metaphor prompts: "Think of the most boring high-school or college class that you've ever had. What was it like to sit through?" Examples of metaphoric stems were provided as potential starting points (e.g., "Being in that class was like…"). The second prompt stated: "Think about the most disgusting thing you ever ate or drank. What was it like to eat or drink?" Stems were also provided for this prompt (e.g., "Eating that ____ was like…").

Instructions for this task included several descriptive terms to distinguish the characteristics of a creative response (see Appendix D). We asked participants to "be creative" and "to come up with something that is clever, humorous, original, compelling, or interesting." Previous studies of divergent thinking have demonstrated that instructions to "be creative" typically result in more unique responses, compared to vague instructions that usually yield stereotyped responses (Christensen, Guilford, & Wilson, 1957; Harrington, 1975; Niu & Liu, 2009). For the present study, it was particularly important to discriminate between conventionality and creativity, especially since participants had just completed the conventional metaphor task. Examples of creative metaphors included figurative statements that were more elaborate and variable than the conventional metaphor samples.

Responses were scored by three raters using subjective scoring (Amabile, 1982; Christensen, Guilford, & Wilson, 1957; Silvia, 2011; Silvia et al., 2008). Each metaphor received a score of 1 (*not at all creative*) to 5 (*very creative*). Raters were trained to score responses based on three criteria: remoteness, novelty, and cleverness. Remoteness reflects the conceptual distance of the metaphor – the extent to which the vehicle related to the topic abstractly. Novelty reflects the originality of the response: cliché metaphors and well-known idioms received a low score (e.g., "It was like watching paint dry"). Cleverness reflects the degree to which the response was funny, witty, or interesting. Although there were several criteria, each response received a single score from each rater. The subjective scoring method was used in our prior study of metaphor (Silvia & Beaty, 2012) and has been shown to be a reliable assessment of divergent thinking (Silvia, 2011). Similar to conventional metaphor scoring, raters were blind to each other's scores and the second creative metaphor response of all participants.

Fluid Intelligence (Gf)

Letter sets task. This task presents a series of five letter sets with four letters in each set. Four of the sets follow a specific rule, such as vowel-consonant-vowel-consonant (e.g., ACIF). One of the letter sets does not follow the rule, and the goal is to identify this set. Participants must choose the correct answer from a list of five answer choices. The task included 16 items and was timed for four minutes (see Appendix E; Ekstrom et al., 1976).

Cattell Culture Fair Intelligence Task. The series completion task was adopted from Cattell's Culture Fair Intelligence Test (Cattell & Cattell, 1961/2008). These assessments are considered to be "culture fair" since they exclude both verbal and numerical notation from testing stimuli. Each task item has a row of boxes. Patterns within the boxes changed according to a specific rule, and the objective was to determine the successive element from a list of answer choices. Participants had three minutes to complete 13 problems.

Paper folding task. Like the letter series task, the paper folding task was adopted from the ETS Kit of Factor-Referenced Cognitive Tasks (Ekstrom et al., 1976). This task assesses visual-spatial reasoning ability, which covaries strongly with fluid intelligence (Kane et al., 2004). Each item presented a square piece of paper followed by a series of images that represented the paper being folded and punched with holes. Participants were to imagine the paper being unfolded and determine the final state of the paper from a series of answer choices. The task included ten items and was timed for 3 minutes.

Broad Retrieval Ability (Gr)

Three verbal fluency tasks were administered, and participants had one minute to enter as many responses as they could think of for each. The first prompt required students to generate synonyms for the word *good*, an assessment of associational fluency (Carroll, 1993). The synonyms fluency task was chosen for the study due to its likely contribution to metaphor composition. Coming up with a metaphor – conventional or creative – should tax one's ability to access descriptive vocabulary in memory. After the synonyms task, two other verbal fluency tasks were administered: a word fluency task (words that start with the letter *M*), followed by an ideational fluency task (o*ccupations*). The *letter M* task required participants to generate as many different words that start with *M*, while the *occupations* prompt required the generation of types of jobs (Carroll, 1993).

Responses for all of the fluency tasks received two scores: overall output and adjusted output. The total number of responses – regardless of accuracy and repetition – was summed to calculate the overall output score. Adjusted output removed repetitive and invalid responses. The adjusted score was used in the analysis.[1]

[1] Although we did not measure typing speed in this study, in hindsight, we considered it to be potentially confounded with performance on the speeded Gr tasks. However, in a separate recent study of Gr (n = 131),

Crystallized Intelligence (Gc)

Vocabulary. Two tests were borrowed from the ETS Kit of Factor-Referenced Cognitive Tasks to assess vocabulary knowledge: the Advanced Vocabulary Test II (18 items, 4 minutes) and the Extended Range Vocabulary Test (24 items, 4 minutes; Ekstrom et al., 1976). Questions from both tests presented a target word with four to five answer choices listed below (see Appendix F). Participants were asked to choose the word that best described the target word.

General knowledge tests. A series of multiple choice questions were administered from three general knowledge domains: general biology, literature, and American history. While there are many areas of specialized knowledge, the intent of the general knowledge tests was to obtain a measure of knowledge in common fields of study. Since the sample of the present study was comprised of undergraduate students, it was reasonable to assume that coursework in these fields was completed by nearly all participants prior to college. Literature questions were compiled from various subject texts. The history and biology test items came from high school advanced placement (AP) study guides (see Appendix G). AP test guides have been used in past research to assess crystallized intelligence (Ackerman, 1999). Questions were taken from practice tests and chosen based on a criterion of medium difficulty. Participants had 10 minutes to answer 30 questions (10 from each domain).

Additional Questionnaires

Following the cognitive tasks, participants completed the Creative Achievement Questionnaire (CAQ; Carson, Peterson, & Higgins, 2005) and the NEO Five Factory Inventory (FFI; Costa & McCrae, 1992). Appendix H contains copies of both questionnaires. The CAQ asks questions about the frequency of personal accomplishments in 10 domains, such as art and scientific discovery, and is a widely used assessment of creative achievement (Silvia, Wigert,

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we found near-zero correlations between typing speed and several measures of broad retrieval ability (synonyms for *good*, $r = .058$; occupations, $r = .013$; words that start with the letter *M*, $r = -.022$).

Reiter-Palmon, & Kaufman, 2012).[2] The NEO FFI was included in the study to assess the contribution of personality factors. The questionnaire consists of 60 items and measures five factors of personality: openness to experience, neuroticism, extraversion, agreeableness, and conscientiousness (McCrae & Costa, 1997). Items consist of statements that reflect one of the five factors, and participants rate the statements on a five-point scale (1 = *strongly disagree*; 5 = *strongly agree*). Of the five factors, openness to experience is the most consistently associated with creativity (Feist, 1998; McCrae, 1987; Silvia, Nusbaum, Berg, Martin, & O'Connor, 2009) and with intelligence (Aston, Lee, & Vernon, 2000; Goff & Ackerman, 1992). Obtaining a measure of personality was thus important to include in the present study to determine the incremental validity of intelligence.

[2] In our past research, we administered a paper and pencil version of the CAQ. For the present study, however, we employed a newly programmed version using MediaLab. Upon analyzing participant responses to the questionnaire, it appeared there was substantial confusion with the instructions. Participants were asked to indicate their achievements within each creative domain, and these items were presented in terms of increasing accomplishment. People could check as many items as they wished, but few people did, and no one selected any of the highest-level items (the items with asterisks). This pattern is unusual for a sample of this size and contrary to our past pencil-and-paper work. As a result, the CAQ scores were much lower and less variable than usual. A reprogrammed MediaLab version used in a recent study behaved like our past pencil-and-paper version, which further leads us to suspect that the version of the CAQ used in the present study was invalid. For these reasons, the CAQ scores were not analyzed.

CHAPTER III

RESULTS

Model Specification

The data were analyzed with structural equation models, using Mplus 6.12 with maximum likelihood estimation. Dependent variables included conventional and creative metaphor, and independent variables were the cognitive abilities. Prior to analyzing the full structural model, we ran confirmatory factor analyses (CFA) to test the loadings of all measures and model fit. The three factors of intelligence were modeled as latent variables – Gr, Gc, and Gf – indicated by scores on their respective tasks (see Figure 1 in Appendix B). Creative and conventional metaphors were also modeled as latent variables, indicated by the scores of the raters.

Intelligence. Our first model analyzed the factor structure of the three intelligence variables. The variances of Gf, Gc, and Gr were fixed to 1. A CFA of the specified model suggested good fit: χ^2 (41 *df*) = 58.47, p = .047; CFI = .94; SRMR = .049; RMSEA = .047 (90% CI: .012, .073). However, the Gc variable showed mixed loadings for the five indicators. Specifically, the Biology and Literature measures loaded poorly on the Gc factor (see Figure 1). Further analysis of internal consistency reflected weak correlations between test items for Biology (Cronbach's α = .10) and Literature (α = -.07). The History test loaded moderately on the Gc factor and showed weak but adequate internal consistency (α = .50). The two Vocabulary tests were the most robust indicators of our Gc factor, consistent with past research linking vocabulary knowledge most closely with crystallized intelligence (Carroll, 1993). Factor loadings for the Gf and Gc latent variables were moderate in magnitude. The revised CFA (see Figure 2 in Appendix

B), with the Biology and Literature variables excluded from the model, showed good fit: χ^2 (24 *df*) = 41.08, *p* = .016; CFI = .94; SRMR = .049; RMSEA = .061 (90% CI: .026, .092). As a comparison, we considered the fit of an implausible model: a general intelligence variable was specified with all nine intelligence tests serving as indicators. This model showed considerably worse fit: χ^2 (27 *df*) = 134.128, *p* = .000; CFI = .633; SRMR = .101; RMSEA = .144 (90% CI: .120, .168).

Creative metaphor. Scores from the two creative metaphor tasks were specified as categorical variables. Similar to our past research analyzing subjective ratings of verbal creativity tasks (e.g., Nusbaum & Silvia, 2011), we found the distribution of scores to be highly skewed. A majority of responses received low scores from the four raters, and very few were coded at the upper end of the scale (i.e., 4s and 5s). This level of skew violates the assumption of multivariate normality and leads to issues with model convergence (Kline, 2011). Modeling the scores as ordinal handles the skewed ratings by estimating the likelihood of each score (i.e., 1-5) without making the assumption of normal distribution (Nusbaum & Silvia, 2011; Silvia & Beaty, 2012).

Each metaphor – "gross food" and "boring class" – was specified as a lower-order latent variable, indicated by the four raters' scores (see Figure 3). We also specified a higher-order creative metaphor factor with the "gross food" and "boring class" variables as indicators. The paths were constrained to be equal so that the higher-order variable could be identified. The variance of this higher-order factor was fixed to 1. One notable issue with analyzing categorical variables in structural equation models is the shortage of fit statistics suitable to assess model fit. However, the structural model reached convergence, which is an indication of an admissible solution (Kline, 2011), and the factor loadings were all relatively large. We have also specified

similar structural equation models in our previous study of cognitive ability and creative metaphor (Silvia & Beaty, 2012).

Intelligence and Creative Metaphor

We analyzed the direct effects of Gf, Gc, and Gr on the quality of creative metaphors. Figure 3 depicts the structural model and standardized effects (see Table 3 in Appendix A for correlations between latent variables). As expected, fluid intelligence strongly predicted creative metaphors ($\beta = .45$, $p = .017$). This effect size can be interpreted as "large" using the benchmarks of .10 for small, .30 for medium, and .50 for large (Cohen, 1988). Interestingly, the magnitude of this effect was similar to our previous study ($\beta = .49$; Silvia & Beaty, 2012). The most surprising result came from the effect of Gr on metaphor creativity ($\beta = .52$, $p = .001$). Finally, the effect of Gc on metaphor quality was moderate but nonsignificant ($\beta = .24$, $p = .206$).

Intelligence and Conventional Metaphor

Conventional metaphor was modeled as a latent variable indicated by the two raters' scores. The lower-order rating variables were constrained to be equal, and the higher-order factor's variance was fixed to 1 for model identification. Similar to the procedure described in Chiappe and Chiappe (2007), we computed an average of each participant's total score on all 24 items. The inter-rater reliability for the two raters was quite high (Cronbach's $\alpha = .97$). Results from the structural model produced a significant effect of Gc on metaphor ratings ($\beta = .30$, $p = .005$). However, the direct effects of Gf ($\beta = .10$, $p = .371$) and Gr ($\beta = .08$, $p = .469$) were small and nonsignificant (see Figure 3). These findings point to a negligible role of executive abilities, but a moderate influence of general knowledge in conventional metaphor production. It is worth noting that we estimated the effects of intelligence on conventional metaphor using structural equation modeling, whereas Chiappe and Chiappe (2007) used ANOVA models. While the

present study differs in this regard, analyzing latent variables typically yields larger effects than observed variables (Kline, 2011; Silvia, 2008).[3]

Personality and Metaphor Production

We assessed the role of personality in producing both types of metaphor. First, we entered the five factors of personality (Costa & McCrae, 1992) into a model as predictors of creative metaphor. The factors were specified as observed variables to simplify the large model. Table 1 displays a summary of the standardized regression coefficients (see Appendix A). Consistent with past research on personality and creativity (Batey & Furnham, 2006; Feist, 1998; McCrae, 1987), openness to experience had a substantial effect on metaphor quality ($\beta = .61$, $p = .000$). All other personality variables had small and nonsignificant effects. A second model included the personality variables as predictors of creative metaphor along with the three intelligence factors. This allowed for a test of incremental validity of the CHC variables. Openness again predicted creative metaphors ($\beta = .35$, $p = .006$). The effect sizes for Gf and Gr remained stable, while the effect of Gc on creative metaphors was reduced to zero ($\beta = -.02$, $p = .945$). Previous studies have shown moderate correlations between Gc and openness (Aston, Lee, & Vernon, 2000; Goff & Ackerman, 1992), so the diminished effect observed between models is likely due to their shared variance.

Regarding conventional metaphor, a model specified with the personality variables as predictors yielded small effects for conscientiousness ($\beta = -.16$, $p = .045$) and openness ($\beta = .14$, $p = .051$). Including personality in a model with Gf, Gr, and Gc predicting conventional metaphor quality yielded similar effects for the IQ variables (see Table 1). However, the effects of

[3] Although the present study followed Chiappe and colleagues' procedure for scoring vehicle aptness, we explored alternate scoring methods to see if they would influence the model results. One such method recoded responses ranging from zero to three as 0, and those from four to five as 1, effectively scoring vehicles as "apt" or "inapt." This procedure yielded a similar pattern of effect sizes in regard to the intelligence variables (e.g., Gf, $\beta = .12$, $p = .277$; Gc, $\beta = .34$ $p = .002$), with the most notable change being a decrease in the effect of Gr on conventional metaphor ($\beta = -.04$, $p = .724$).

conscientiousness (β = -.09, p = .274) and openness (β = .03, p = .752) were decreased. Taken together, the inclusion of personality factors in a model with the intelligence variables influenced the weak coefficients for conventional metaphor most significantly, whereas the large effects of Gf and Gr on creative metaphors were largely unchanged.

CHAPTER IV

DISCUSSION

The present study provides several insights into the nature of figurative language use and expands the assessment of everyday creativity within a classic model of cognitive abilities (Carroll, 1993). Our results demonstrate the differential contribution of cognitive abilities to the generation of creative and conventional metaphors. One goal of the present research was to replicate the results from our previous study of creative metaphor (Silvia & Beaty, 2012). Specifically, we again tested the hypothesis that fluid intelligence would predict the creative quality of metaphors. Structural equation models revealed this effect to be almost identical to our prior analysis. Including additional factors of intelligence in the present analysis allowed us to extend our previous study and take a closer look at other underlying mechanisms involved in creative ideation.

Recent studies have reported close links between conventional metaphor generation and higher-order executive processes (e.g., Chiappe & Chiappe, 2007; Pierce & Chiappe, 2009). In our study, however, fluid intelligence had a small effect on conventional metaphor production. This observation does not entirely negate the results from Chiappe and Chiappe's (2007) work: they measured the effect of executive mechanisms with assessments of working memory and controlled attention, although the effects on conventional metaphor quality were small and nonsignificant in some cases. Nevertheless, considering the strong association between fluid intelligence and working memory capacity (Kane, Hambrick, & Conway, 2006), one would expect at least a modest relation between Gf and conventional metaphor. Our study bolstered the likelihood of observing this relationship by analyzing latent variables, which remove

measurement error and typically yield larger effect sizes (Kline, 2011).

The results for crystallized intelligence in the present analysis provide support for the notion that conventional metaphor generation taps stored information in memory. Vocabulary knowledge accounted for the most variance in Chiappe and Chiappe's (2007) study, which one might expect since the task essentially involves completing an incomplete definition with an appropriate term. Thus, producing conventional metaphors might simply entail drawing upon prior knowledge and needn't recruit executive resources. On the other hand, the results for crystallized intelligence and creative metaphor quality are not as clear, considering that our latent Gc factor did not significantly predict the creative quality of metaphors and had essentially no effect after controlling for personality.

Another notable result from the present analysis involved the strong relation between Gr and creative metaphor. Crafting a novel metaphor should recruit selective retrieval processes, so we expected Gr to play a role, although the magnitude of this effect was greater than we anticipated ($\beta = .52$). In light of past research, however, one might expect Gr to contribute to creative ideation. For example, Carroll's (1993) CHC model of intelligence includes divergent thinking as a facet of Gr. Creative metaphor production could be considered a close cousin of divergent thinking, although the tasks used to measure these constructs differ in their demands (e.g., the elaboration of a single response in creative metaphor generation versus the generation of several alternate uses for an object in divergent thinking). Nevertheless, the theoretical basis of broad retrieval ability should be developed further to better understand its function in metaphor production.

The function of retrieval ability might not be surprising when considered in terms of Glucksberg's (2001) property attribution model. Glucksberg posited that the process by which we comprehend a figurative statement includes the creation and maintenance of a superordinate

attributive category that serves to relate the topic of a metaphor to a vehicle (Glucksberg et al., 1997). Such a mechanism has been adopted in recent models of metaphor generation (e.g., Chiappe & Chiappe, 2007; Silvia & Beaty, 2012). In a typical selective retrieval task, one must deploy a given search cue (e.g., "words that start with the letter *M*") to extract relevant information from long-term memory. This type of targeted search process also fits with our conceptualization of metaphor use. Producing a novel metaphor – one that meets certain abstract criteria – should recruit selective retrieval mechanisms vis-à-vis a higher-order attributive category. In our experiment, participants had to form an attributive category for "things that are gross" and selectively retrieve exemplars that satisfied these criteria. The close resemblance in task demands thus helps to explain the large effect of Gr on creative metaphor quality.

Strengths, Limitations, and Directions for Future Research

Our results provide insights into the role of several factors of intelligence to metaphor production. In particular, the effect of fluid intelligence on creative metaphor quality observed in our earlier study was replicated in the present analysis. This finding is notable in light of the additional factors of intelligence that were included in a model predicting metaphor quality: Gf still had a substantial effect on metaphor creativity over and above the effects of Gr and Gc. Moreover, showing a significant role of retrieval ability on creative metaphors provides an extension of our model of metaphor production, and further demonstrates the importance of intelligence to creative thought (Nusbaum & Silvia, 2011; Silvia & Beaty, 2012). Nevertheless, there are a few limitations worth mentioning.

The latent Gc factor modeled for this study had to be modified from its original form due to poor performance of some tasks. We developed these tasks to assess general knowledge of high-school-level subject matter, and assumed our undergraduate sample would produce normally distributed results. As mentioned in the results section, the internal consistencies for the biology

and literature tests were exceedingly low. The resulting Gc factor was therefore not as broad as we had hoped. Future studies of general knowledge should include more reliable and vetted assessments.

One challenge of interpreting the findings for creative metaphor is discerning the underlying functions of Gf and Gr. We have previously implicated Gf in the strategic search process, although the present results point to an important role for broad retrieval ability. Perhaps Gr is largely responsible for scanning and extracting potential vehicles from long-term memory, whereas Gf functions to exercise top-down control over the task. Our previous studies have shown Gf to be broadly important to divergent thinking (Nusbaum & Silvia, 2011) and creative metaphor generation (Silvia & Beaty, 2012), but the exact functions of this higher-order ability remain unclear. Other lines of research provide some insight into the executive functions associated with fluid intelligence. For example, Unsworth (2010) demonstrated that several measures of inhibition were strongly related to Gf. This observation is in line with the large correlation reported between fluid intelligence and working memory capacity (Kane et al., 2004; Süß et al., 2002).

Future research should examine the mechanics of creative metaphor generation more directly. Teasing apart the mechanisms involved in vehicle selection would be one fruitful direction. Developing an experimental manipulation of attributive category use during creative metaphor generation might further illuminate the targeted search processes. The use of attributive categories during metaphor generation could be manipulated experimentally by providing categories that vary in terms of semantic constraints. Presumably, individuals who score highly on Gr tasks should be better at deploying different categories, so it would be important to assess individual differences in broad retrieval ability as well.

Another important direction to explore is the underlying function of Gf and executive processes in creative metaphor production. To illuminate the role of controlled attention, one approach to take would be to induce different types of interference during a metaphor generation task. Providing examples of novel products before a creativity task has been shown to constrain subsequent ideation (i.e., the conformity effect; Smith, Ward, & Schumacher, 1993), so presenting example metaphors and asking people to come up with a novel exemplar might highlight the interference effect. In addition, generating a second metaphor to the same prompt might also promote interference, as the first metaphor could act as a self-generated example, and "breaking set" from this template should be difficult.

CHAPTER V

CONCLUSION

Figurative language is a common mode of communication, but the cognitive processes that support both creative and conventional metaphor use are not well understood. Our analysis revealed that higher-order mechanisms associated with executive processes predicted the quality of creative metaphors, while crystallized knowledge predicted peoples' ability to generate conventional metaphors. Taken together, the present research provides new evidence for the differential contribution of intellectual abilities to metaphor production, and it extends the study of creative cognition within the CHC intelligence framework.

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APPENDIX A

TABLES

Table 1. Summary of the Regression Effects

Model	Creative Metaphor			Conventional Metaphor		
	Standardized Beta	*p* value	95% Confidence Interval	Standardized Beta	*p* value	95% Confidence Interval
1. CHC						
Gf	.45	.017	.08, .83	.10	.371	-.11, .30
Gr	.52	.001	.23, .82	.08	.469	-.13, .29
Gc	.24	.206	-.13, .62	.30	.005	.09, .51
2. Personality						
Neuroticism	.14	.366	-.16, .44	.00	.933	-.16, .15
Extraversion	-.26	.120	-.59, .07	-.08	.313	-.23, .08
Openness to Experience	.61	.000	.38, .85	.14	.051	.00, .29
Agreeableness	.22	.188	-.11, .55	.03	.730	-.13, .18
Conscientiousness	-.08	.614	-.41, .24	-.16	.045	-.32, .00
3. CHC & Personality						
Gf	.45	.013	.10, .80	.09	.405	-.12, .30

Gr	.55	.000	.25, .85	.05	.677	-.18, .28
Gc	-.02	.945	-.47, .44	.29	.035	.02, .56
Neuroticism	.04	.743	-.19, .27	.00	.996	-.15, .15
Extraversion	-.32	.056	-.64, .01	-.02	.872	-.18, .22
Openness to Experience	.35	.006	.10, .60	.03	.752	-.13, .19
Agreeableness	.14	.286	-.12, .41	-.02	.796	-.18, .14
Conscientiousness	.12	.359	-.14, .37	-.09	.274	-.25, .07

Note. n = 191.

Table 2. Correlations and Descriptive Statistics

	M	*SD*	Min, Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Gross Metaphor: Rater 1	1.13	.38	1, 3	1																		
2. Gross Metaphor: Rater 2	1.29	.67	1, 4	.43	1																	
3. Gross Metaphor: Rater 3	1.37	.65	1, 4	.48	.63	1																
4. Gross Metaphor: Rater 4	1.25	.54	1, 3	.53	.58	.63	1															
4. Boring Metaphor: Rater 1	1.18	.46	1, 4	.21	.16	.13	.13	1														
5. Boring Metaphor: Rater 2	1.26	.56	1, 4	.00	.02	-.01	-.04	.09	1													
6. Boring Metaphor: Rater 3	1.33	.62	1, 4	.05	.05	.14	.15	.35	.25	1												
8. Boring Metaphor: Rater 4	1.33	.55	1, 3	.00	.08	.13	.08	.23	.34	.52	1											

9. Conventional Metaphor Avg.: Rater 1	3.80	.64	.96, 4.96	.00	.12	.05	.00	.06	.05	.14	.05	1										
10. Conventional Metaphor Avg.: Rater 2	3.51	.61	.88, 4.83	.06	.15	.09	.05	.83	.05	.14	.03	.92	1									
11. Gf: Series Completion	7.87	1.66	1, 11	.01	.09	.21	.05	-.03	-.07	.22	.02	.22	.20	1								
12. Gf: Paper Folding	5.76	2.16	0, 10	.06	-.02	.22	.07	-.04	-07	.34	.07	.15	.15	.36	1							
13. Gf: Letter Sets	8.31	2.62	2, 14	.04	-.02	.26	.01	-.07	-.04	.28	.14	.11	.12	.40	.40	1						
14. Gr: Jobs	12.20	3.06	3, 23	.20	.04	.14	.15	.11	.23	.08	.12	.17	.15	.09	.06	.14	1					
15. Gr: Letter *M*	14.61	3.61	3, 24	.12	.08	.11	.07	.10	.04	.16	.19	.11	.15	.06	.07	.12	.38	1				
16. Gr: Synonyms for *Good*	7.92	2.98	2, 20	.19	.13	.27	.23	.20	.00	.15	.13	.07	.07	-.04	.11	.21	.35	.33	1			
17. Gc: Extended Vocabulary Avg.	10.08	3.37	1, 19	.17	.08	.16	.15	.13	.07	.37	.21	.23	.23	.20	.31	.30	.24	.09	.19	1		
18. Gc: Advanced Vocabulary Avg.	7.79	2.50	1, 14	.20	.12	.13	.12	-.01	-.09	.11	.06	.24	.26	.17	.23	.10	.18	.07	.09	.54	1	
19. Gc: History Avg.	4.35	1.96	0, 10	.14	.08	.01	.02	.02	.00	.10	.15	.28	.31	.16	.03	.17	.23	.11	.05	.38	.43	1

Table 3. Correlations Between Latent Variables

	1	2	3	4	5
1. Creative Metaphor	1				
2. Conventional Metaphor	.41	1			
3. Fluid Intelligence	.82	.31	1		
4. Broad Retrieval Ability	.82	.28	.40	1	
5. Crystallized Intelligence	.79	.43	.60	.50	1

APPENDIX B

FIGURES

Figure 1. Original Intelligence Confirmatory Factor Analysis

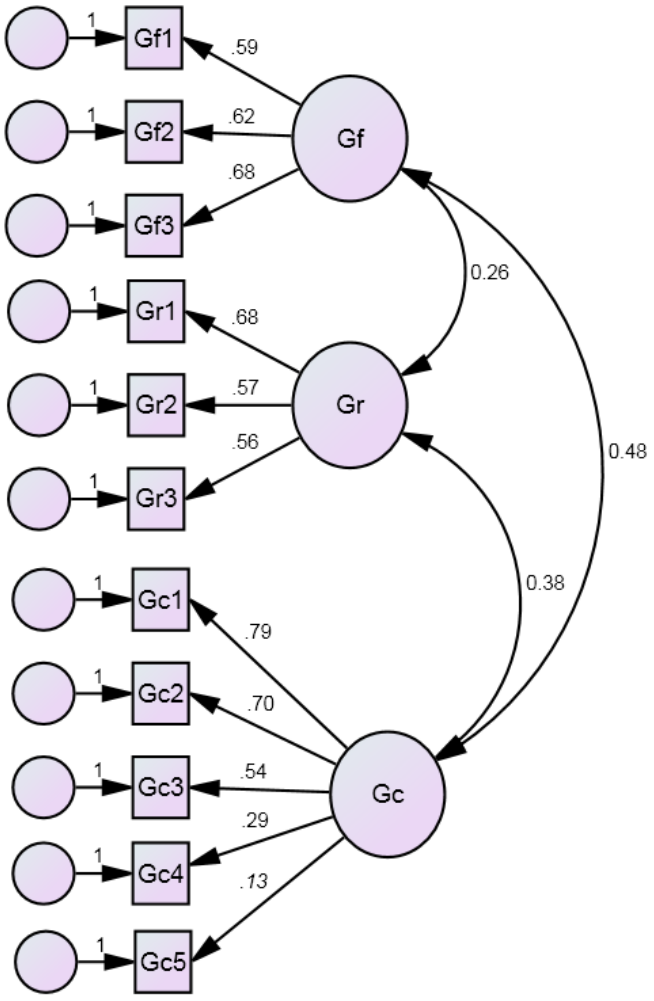


Figure 1. A model depicting the original CFA of three intelligence factors (Gf, Gr, and Gc). All factor loadings are standardized. Italicized values are not significant at $p < 0.05$. Abbreviated indicator labels for the intelligence factors represent the following tasks: Gf1 = Cattell Series Completion, Gf2 = Paper Folding, Gf3 = Letter Sets; Gr1 = Jobs, Gr2 = Letter *M* Words, Gr3 = "Good" Synonyms; Gc1 = Extended Vocabulary, Gc2 = Advanced Vocabulary, Gc3 = US History, Gc4 = Biology, and Gc5 = Literature.

Figure 2. Revised Intelligence Confirmatory Factor Analysis

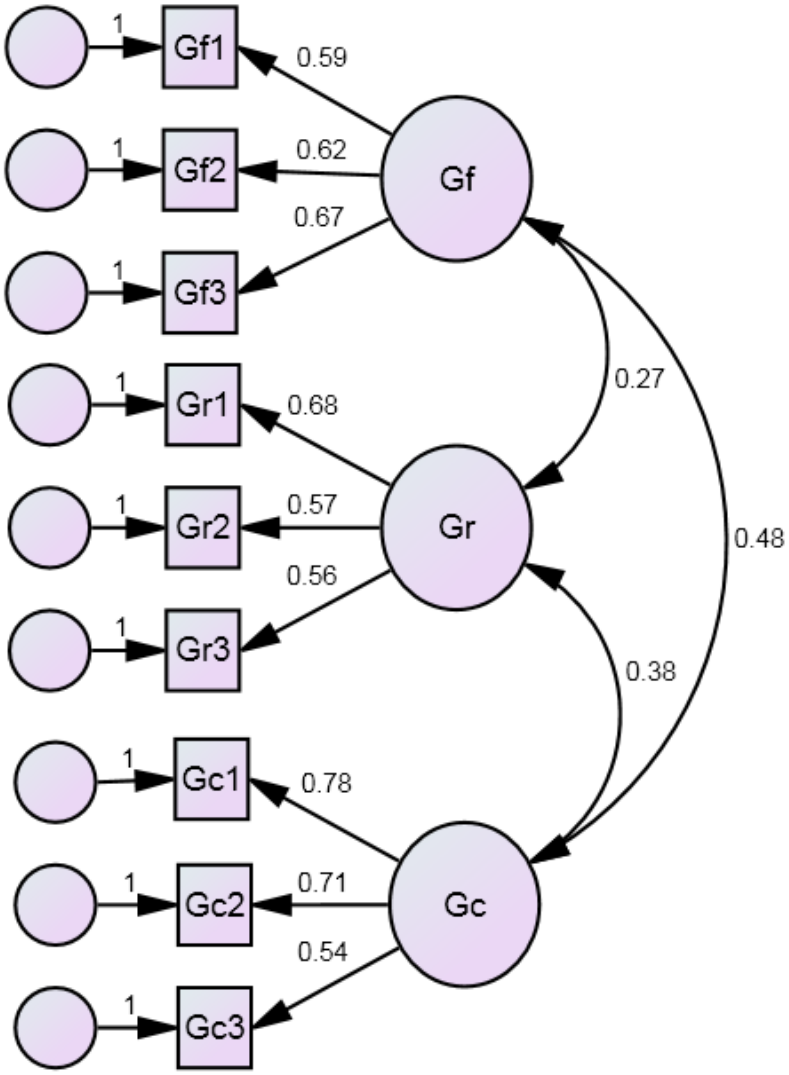


Figure 2. A depiction of the revised intelligence CFA with biology (Gc4) and literature (Gc5) indicators excluded from the Gc latent factor. Indicators of other variables are identical to those in Figure 1. The model showed good fit: χ^2 (24 *df*) = 41.08, *p* = .016; CFI = .94; SRMR = .049; RMSEA = .061 (90% CI: .026, .092).

Figure 3. Structural Regression Model

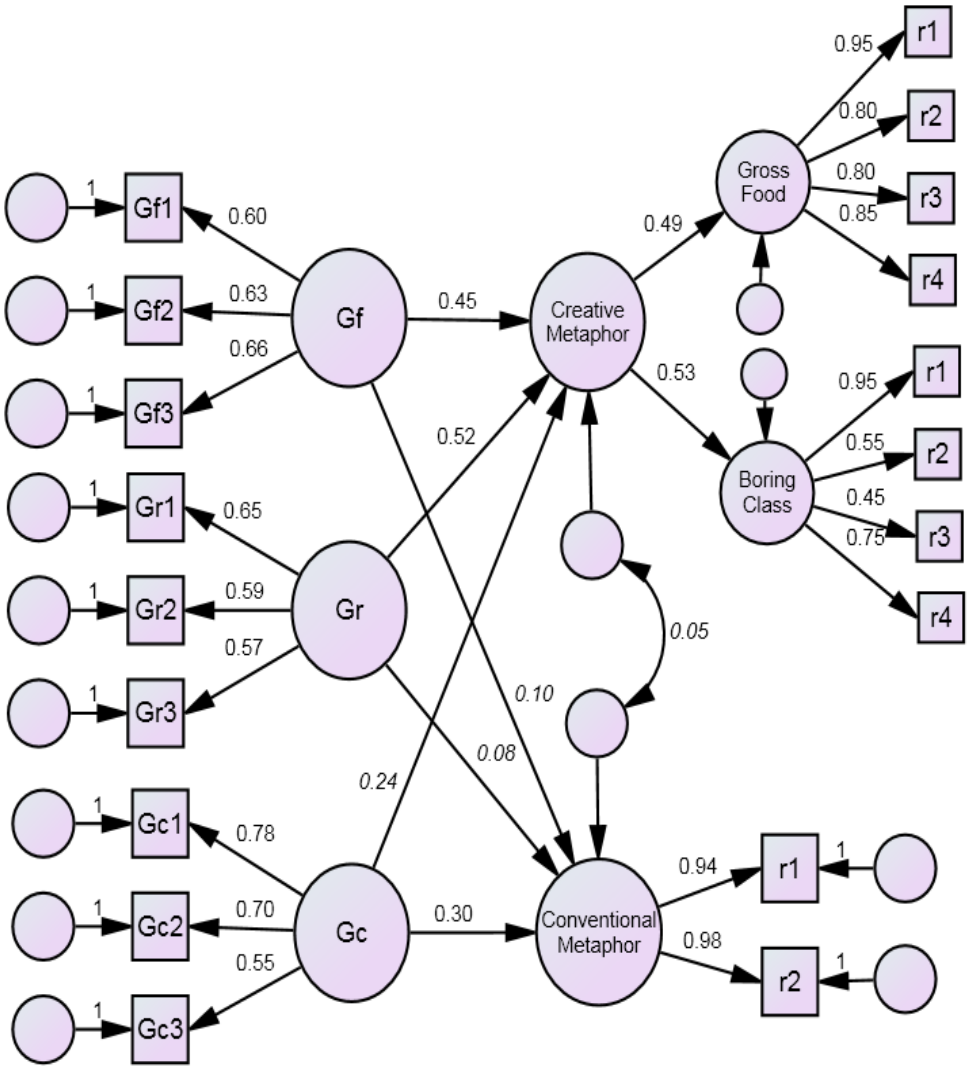


Figure 3. A model depicting the standardized effects and loadings of three of intelligence factors (Gf, Gr, and Gc) and two types of metaphors (conventional and creative; indicators are the raters' scores for the tasks). The creative metaphor rating indicators are ordinal and thus do not have residual variances. Italicized values are not significant at $p < 0.05$. Abbreviated indicator labels for the intelligence factors represent the following tasks: Gf1 = Cattell Series Completion, Gf2 = Paper Folding, Gf3 = Letter Sets; Gr1 = Jobs, Gr2 = Letter *M* Words, Gr3 = "Good" Synonyms; Gc1 = Extended Vocabulary, Gc2 = Advanced Vocabulary, and Gc3 = US History. The correlations between Gf, Gr, and Gc were omitted for clarity. The correlation between Gr and Gf was .27; Gc and Gf was .48; Gc and Gr was .38.

APPENDIX C

CONVENTIONAL METAPHOR GENERATION TASK

Instructions. In what follows, your task will be to create some metaphors. A metaphor is a figurative statement that has two parts. Each metaphor has a topic and a vehicle term. For instance, for the metaphor "giraffes are skyscrapers" the topic is "giraffes" and the vehicle is "skyscrapers". The vehicle term is used to attribute certain properties to the topic. For instance, saying "giraffes are skyscrapers" allows us to attribute the property "very tall" to giraffes. You will be presented with topic terms, as well as the property that needs to be attributed to the topic. You will have to come up with vehicles that enable those properties to be attributed. So, the vehicle terms that you choose for each metaphor should be ones that capture the stated properties.

(1) Come up with a metaphor that conveys that health is fragile and easily broken.

Health _____.

A vehicle that would work in this case is "glass". So, you would type "is a glass" in the space provided beside the topic.

(2) Come up with a metaphor that conveys that billboards are something noticeable and unattractive.

Billboards _____.

A vehicle that would work in this case is "warts." So, you would type "are warts" in the space provided beside the topic.

In some cases, you might think that a property does not apply to a topic very well. You should try to find a suitable vehicle anyways in those cases.

(3) Come up with a metaphor that conveys that some babies are vicious predators.

Some babies _____.

Although you may doubt that this property applies to babies very well, a vehicle for doing so is "wolves." So, you would type that in the space provided.

(4) Come up with a metaphor that conveys that homework is something that can carry you through troubled times.

Homework _____.

Again, though you may doubt that attributing this property to homework is apt, but you should still find a suitable vehicle for doing so, such as "raft."

In short, you have to provide a vehicle for each of the topics below. If after thinking hard about an item you can't come up with a suitable vehicle, please type, "I don't know" beside the topic. But, do your best to try to come up with a vehicle for each one. Remember, you can always ask the experimenter if you ever have questions.

Task Items

1. Come up with a metaphor that conveys the fact that a business is something that needs energy to grow and thrive.
   A business _____.
2. Come up with a metaphor that conveys the fact that his old car is something that is big, heavy, and hard to maneuver.
   His car _____.
3. Come up with a metaphor that conveys the fact that some stomachs are something that is a large container.
   Some stomachs _____.
4. Come up with a metaphor that conveys the fact that some divorces are something violent and frightening that one can hear approaching from the distance.
   Some divorces _____.
5. Come up with a metaphor that conveys the fact that music can be something that heals and makes one feel better.
   Music _____.
6. Come up with a metaphor that conveys the fact that the unconscious is something that is a place where competing ideas can be heard.
7. Come up with a metaphor that conveys the fact that the front lawn is something slippery
   The front lawn _____.
8. Come up with a metaphor that conveys the fact that a wish is something that can cut into you and hurt you.
   A wish _____.
9. Come up with a metaphor that conveys the fact that a best friend is something that keeps you grounded, and prevents you from drifting.
   A best friend _____.
10. Come up with a metaphor that conveys the fact that many jobs are something that is confining and constraining and holds people against their will.

Many jobs _____.

11. Come up with a metaphor that conveys the fact that time is something that is a valuable resource.

    Time _____.

12. Come up with a metaphor that conveys the fact that the planet Earth is something that is round.

    The planet Earth _____.

13. Come up with a metaphor that conveys the fact that sadness is something that can unexpectedly erupt.

    Sadness _____.

14. Come up with a metaphor that conveys the fact that intelligence is something that is big and used to store things for extended periods of time.

    Intelligence _____.

15. Come up with a metaphor that conveys the fact that birds are something that flies fast through the air.

    Birds _____.

16. Come up with a metaphor that conveys the fact that education is something that can light your way

    Education _____.

17. Come up with a metaphor that conveys the fact that a rooster is something that reliably wakes you up every morning.

    A rooster _____.

18. Come up with a metaphor that conveys the fact that my computer skills course is something one shouldn't take seriously.

    My computer skills course _____.

19. Come up with a metaphor that conveys the fact that the mind is something that is a place where competing ideas can be heard.

    The mind _____.

20. Come up with a metaphor that conveys the fact that a lie is something that can cut into you and hurt you.

    A lie _____.

21. Come up with a metaphor that conveys the fact that some comedians are something that puts you to sleep.
    Some comedians _____.
22. Come up with a metaphor that conveys the fact that good news is something that can shake you up and be destructive.
    Good news _____.
23. Come up with a metaphor that conveys the fact that alcohol is something that you can rely on for support.
    Alcohol _____.
24. Come up with a metaphor that conveys the fact that that bedroom is something messy, dirty and where things are disposed of.
    That bedroom _____.

APPENDIX D

CREATIVE METAPHOR GENERATION TASK INSTRUCTIONS

For this task, you'll be asked to come up with creative metaphors to describe things. As a background, there are a few common kinds of metaphors, and you can come up with any kind of them for this task. A *simple metaphor* describes something by equating it to something else. Examples of simple metaphors are "All the world is a stage" (Shakespeare) and "A committee is a cul-de-sac down which ideas are lured and then quietly strangled" (Sir Barnett Cocks). A *simile* (which is a kind of metaphor) describes something by saying it is like something else. An example of a simile is "Justice is like a train that is nearly always late" (Yevgeny Yevtushenko). A *compound metaphor* has a second part that extends and explains the metaphor. Examples are "Life is like a box of chocolates: you never know what you're going to get" (from the film "Forest Gump") and "Men are like a fine wine: they all start out like grapes, and it's our job to stomp on them and keep them in the dark until they mature into something you'd like to have dinner with" (Kathleen Mifsud).

APPENDIX E

FLUID INTELLIGENCE TESTS

LETTER SETS TEST -- I-1 (Rev.)

Each problem in this test has five sets of letters with four letters in each set. Four of the sets of letters are alike in some way. You are to find the rule that makes these four sets alike. The fifth letter set is different from them and will not fit this rule. Draw an X through the set of letters that is different.

NOTE: The rules will not be based on the sounds of sets of letters, the shapes of letters, or whether letter combinations form words or parts of words.

Examples:

A.	NOPQ	DEFL	ABCD	HIJK	UVWX
B.	NLIK	PLIK	QLIK	THIK	VLIK

In Example A, four of the sets have letters in alphabetical order. An X has therefore been drawn through DEFL. In Example B, four of the sets contain the letter L. Therefore, an X has been drawn through THIK.

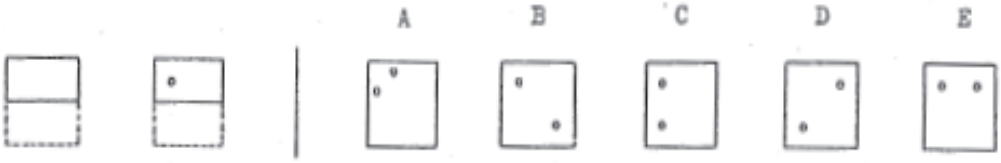
Your score on this test will be the number of problems marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the letter sets.

1.	QPPQ	HGHH	TTTU	DDDE	MLMM
2.	BCDE	FGHI	JKLM	PRST	VWXY
3.	BVZC	FVZG	JVZK	PWXQ	SVZT
4.	BCEF	FGIJ	STWX	CDFG	PQST
5.	BCCB	GFFG	LMML	QRRQ	WXXW
6.	AAPP	CCRR	QQBB	EETT	DDSS
7.	ABDC	EGFH	IJLK	OPRQ	UVXW
8.	CERT	KMTV	FHXZ	BODQ	HJPR
9.	PABQ	SEFT	VIJW	COPD	FUZG
10.	CFCR	JCVC	CGCS	CLXC	KCWC
11.	XDBK	TNLL	VEGV	PFCC	ZAGZ
12.	CAEZ	CEIZ	CIOZ	CGVZ	CAUZ
13.	VEBT	XGDV	ZIFX	KXVH	MZXJ
14.	AFBG	EJFK	GKHM	PSQT	RWSX
15.	KGDB	DFIM	KIFB	HJMQ	LHEC

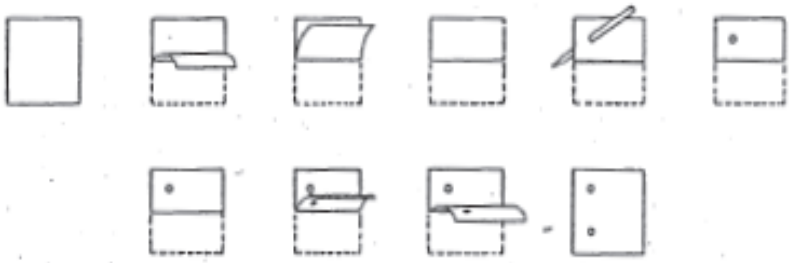
PAPER FOLDING TEST — VZ-2.

In this test you are to imagine the folding and unfolding of pieces of paper. In each problem in the test there are some figures drawn at the left of a vertical line and there are others drawn at the right of the line. The figures at the left represent a square piece of paper being folded, and the last of these figures has one or two small circles drawn on it to show where the paper has been punched. Each hole is punched through all the thicknesses of paper at that point. One of the five figures at the right of the vertical line shows where the holes will be when the paper is completely unfolded. You are to decide which one of these figures is correct and draw an X through that figure.

Now try the sample problem below. (In this problem only one hole was punched in the folded paper.)

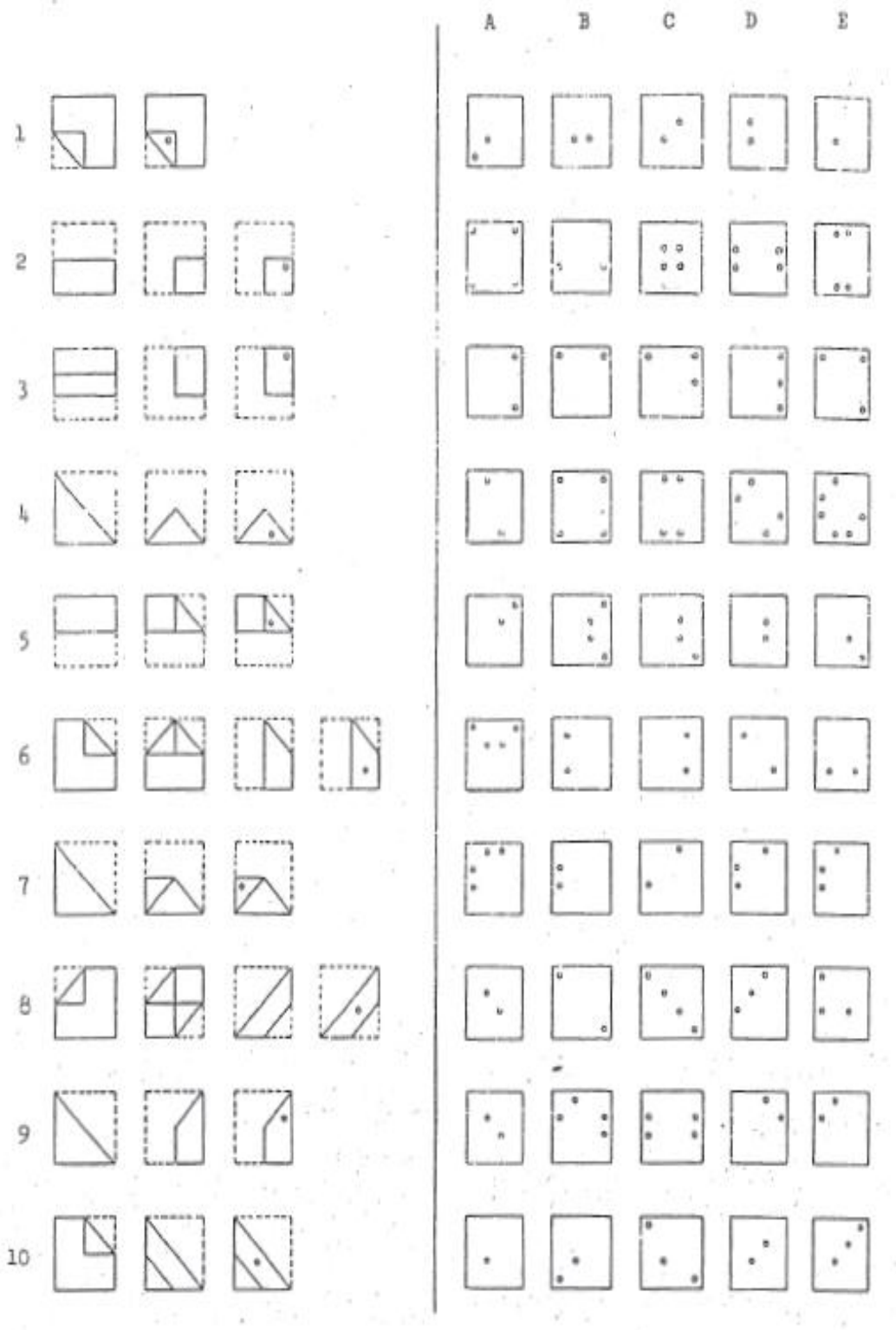


The correct answer to the sample problem above is C and so it should have been marked with an X. The figures below show how the paper was folded and why C is the correct answer.

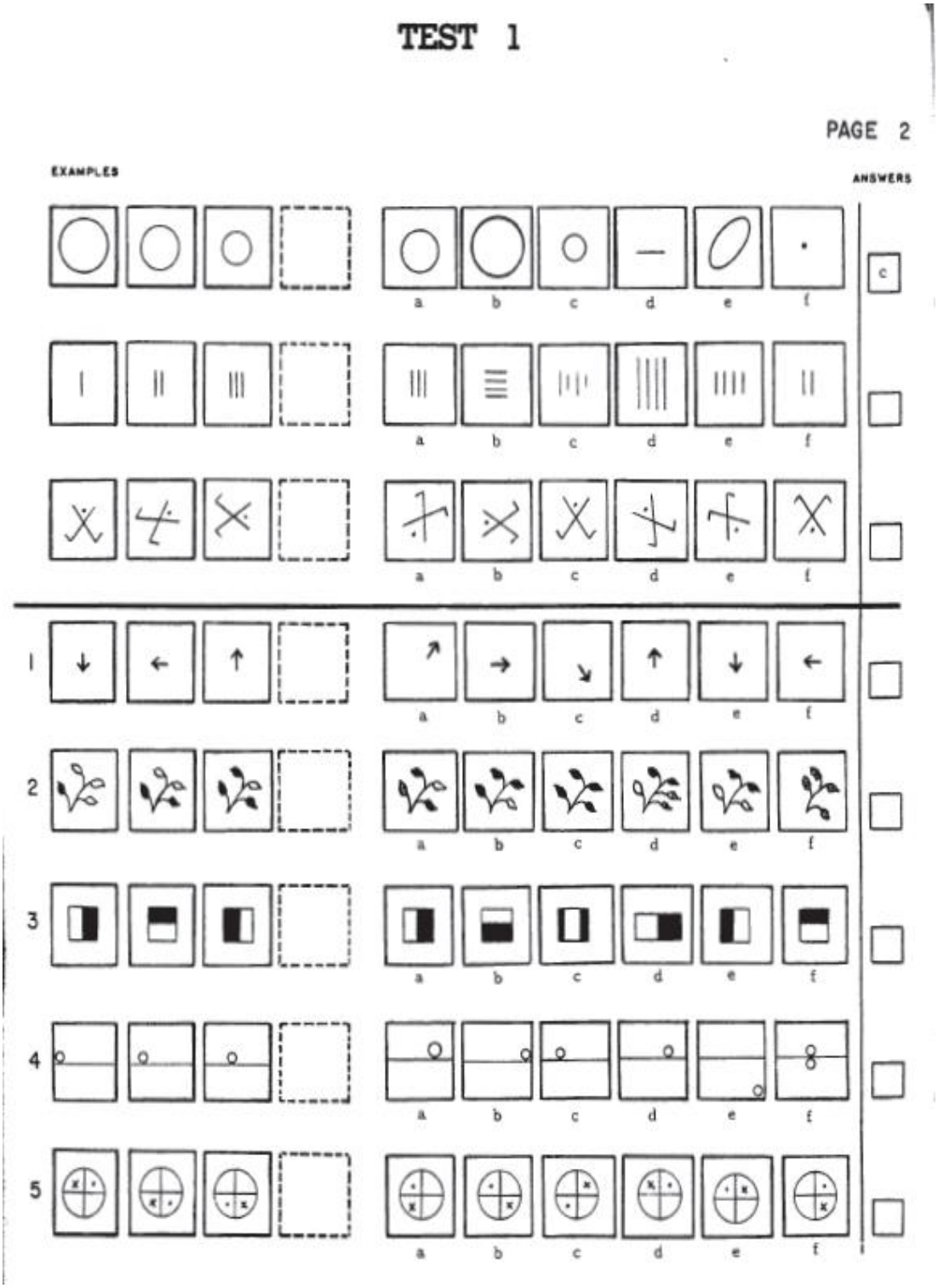


In these problems all of the folds that are made are shown in the figures at the left of the line, and the paper is not turned or moved in any way except to make the folds shown in the figures. Remember, the answer is the figure that shows the positions of the holes when the paper is completely unfolded.

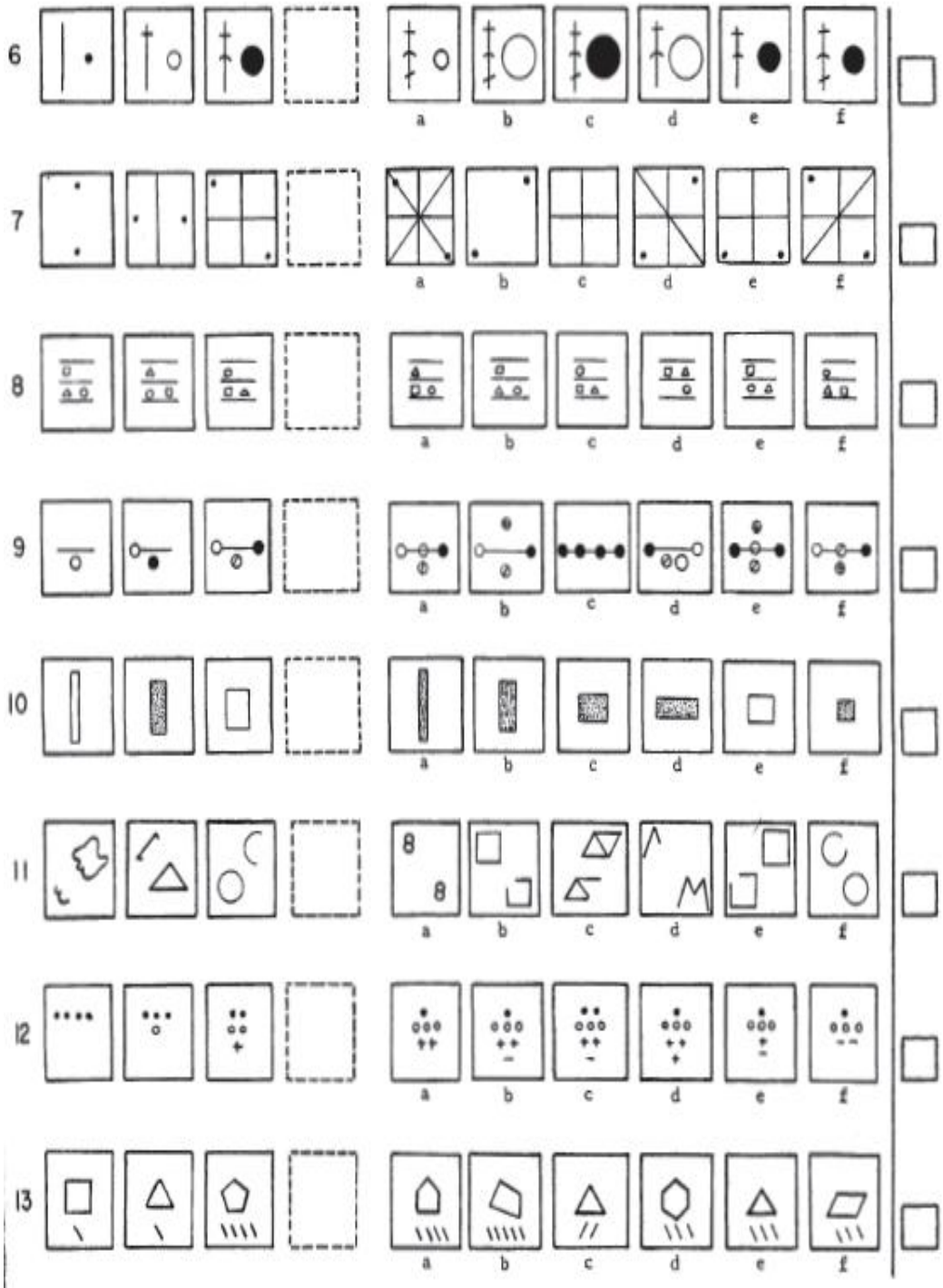
Your score on this test will be the number marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the answer choices as wrong.


A
B
C
D
E
1
2
3
4
5
6
7
8
9
10

Cattell Culture Fair Intelligence Test (Series Completion).



ANSWERS



End of Test 1

APPENDIX F

GENERAL KNOWLEDGE TESTS

Instructions. The following section contains questions of general knowledge from three domains: history, biology, and literature. You will be presented with a question followed by a series of answer choices. Please click on the option that best answers the question.

History Test Items. (*Note*: Bolded answer choices represent the correct answer.)

1. All of the following were causes of the Great Depression EXCEPT
    a) a weak foreign trade
    b) an overextension of credit
    c) agricultural overproduction
    d) the establishment of public works projects
    e) an unequal distribution of wealth
2. The 1956 boycott of the Montgomery bus system
    a) was led by Malcolm X
    b) started because the city doubled bus fares
    c) **was instigated by the arrest of Rosa Parks**
    d) lasted for three weeks and failed to achieve its goal
    e) resulted from the assassination of Martin Luther King Jr.
3. The Bay of Pigs invasion of Cuba, in 1961, was carried out by
    a) Caribbean mercenaries hired by the United States
    b) American soldiers
    c) the Soviet navy
    d) Cuban exiles trained by the Central Intelligence Agency
    e) Cuban Communist rebels led by Fidel Castro
4. Loyalty oaths, blacklists, and Alger Hiss are all associated with the
    a) civil rights movement
    b) New Deal
    c) **Red Scare**
    d) Great Society
    e) Jazz Age

5. The Louisiana Purchase was an important factor in the development of U.S. trade because it
    a) opened new markets among the western Indian nations
    b) **gave the country complete control of the Mississippi River**
    c) added numerous French factories in the Louisiana Territory to the U.S. economy
    d) facilitated the immediate completion of the transcontinental railroad
    e) allowed the United States to develop ports on the Pacific coast
6. Thomas Jefferson relied on the ideas of John Locke in writing the American Declaration of Independence in all of the following ways EXCEPT Locke's belief that
    a) man is born free and equal
    b) **man must submit to the General Will to protect his natural rights**
    c) governments get their authority from the people, not God
    d) the purpose of government is to protect man's natural rights
    e) people can overthrow a government that violates man's natural rights
7. Which of the following acts of the British government in the period preceding the Revolutionary War provoked the most outrage among the colonists?
    a) Parliament's defense of "virtual representation"
    b) The monopoly given to the British East India Company
    c) The passage of the Boston Port Act
    d) The passage of the Molasses Act
    e) The passage of the Quebec Act
8. The incident that began a chain of events that became one of the most infamous presidential scandals in American history and eventually led to the resignation of Richard Nixon was the
    a) burglary of Daniel Ellsberg's psychiatrist's office
    b) political sabotage of Nixon's opponent, George McGovern
    c) illegal use of the CIA to hush up the FBI's investigation of the events surrounding the publication of the Pentagon Papers
    d) use of the IRS to play dirty tricks on leading Democrats
    e) **break-in and attempted bugging of the Democratic party's national headquarters**

9. Which of the following best summarizes the United States' primary reason for participating in the war in Vietnam?
    a) The United States was required to fight under the terms of its military alliance with Japan.
    b) Vietnamese leader Ho Chi Ming requested American military assistance.
    c) The United States was hoping to promote Asian autonomy and ant colonialism.
    d) **American foreign policy experts believed that, without intervention, communism would spread from Vietnam throughout Southeast Asia.**
    e) The government felt obliged to protect the United States' considerable business interests in Vietnam.
10. One of the unintended effects of Prohibition was that it
    a) caused a national epidemic of alcohol withdrawal
    b) brought about a decrease in alcoholism and an increase in worker productivity
    c) resulted in a substantial increase in the abuse of hard drugs, particularly heroin
    d) lowered the cost of law enforcement by decreasing the incidence of drunkenness
    e) provided organized crime syndicates with a means to gain both wealth and power

Biology Test Items.

1. Which of the following best explains possible relationships between genotypes and phenotypes?
    a) Different genotypes never produce the same phenotype.
    b) The same genotypes can occur in different phenotypes.
    c) The genotype is equivalent to the phenotype.
    d) The genotype is unrelated to the phenotype.
    e) The genotype and phenotype are the same in siblings.
2. Basic drives such as hunger, thirst, sex, and rage, as well as internal environmental parameters of blood pressure, heart rate, and body temperature, have all been linked to the functioning of
    a) the basal ganglia.
    b) the adrenal gland.
    c) the pineal gland.

d) the hypothalamus.

e) the corpus callosum.

3. Protein synthesis involves the following structures and/or components EXCEPT

a) rough endoplasmic reticulum (RER).

b) ribosomes.

c) messenger RNA (mRNA).

d) transfer RNA (tRNA).

e) lysosomes.

4. A hereditary modification that increases an organism's chance of survival is called

a) a pre-adaptation.

b) an adaptation.

c) speciation.

d) directional selection.

e) stabilizing selection.

5. The pituitary regulates all of the following EXCEPT the

a) thyroid.

b) adrenal cortex.

c) ovaries.

d) testes.

e) adrenal medulla.

6. The myelin sheath of many axons is produced by the

a) node of Ranvier.

b) nerve cell body.

c) Schwann cell.

d) astrocytes.

e) axon hillock.

7. A source of genetic change in a population is

a) catastrophism.

b) fossils.

c) gene flow.

d) mutations.

e) natural selection.

8. Release of simple substances into the ecosystem for use by producers depends on activity of the
    a) carnivores.
    b) decomposers.
    c) herbivores.
    d) primary consumers.
    e) secondary consumers.
9. A man was involved in an accident and suffered extensive damage to the cerebellum. Which of the following functions would he be unable to perform?
    a) Recalling facts prior to his accident.
    b) Driving his car.
    c) Reading for long periods.
    d) Digesting his food.
    e) Distinguishing between hot and cold objects.
10. Which of the following does NOT perform excretory functions?
    a) Kidneys.
    b) Lungs.
    c) Skin.
    d) Liver.
    e) Lymph nodes.

Literature Test Items.

1. Which American author wrote the novel "Go Tell It on the Mountain"?
    a) James Baldwin
    b) John Cheever
    c) Ralph Ellison
    d) William Faulkner
    e) William Styron
2. Which of the following books best represents the "New York School" of poetry?
    a) "A Witness Tree" by Robert Frost
    b) "Colossus" by Sylvia Plath
    c) "Mockingbird Wish Me Luck" by Charles Bukowski

d) "Self-Portrait in a Convex Mirror" by John Ashbery

e) "To Bedlam and Part Way Back" by Anne Sexton

3. Which of the following is NOT a novel by F. Scott Fitzgerald?

a) The Beautiful and Damned

b) The Great Gatsby

c) The Last Tycoon

d) Many Marriages

e) Tender is the Night

f) This Side of Paradise

4. Which of the following writers has NOT received the Nobel Prize for Literature?

a) Saul Bellow

b) Pearl Buck

c) Toni Morrison

d) V. S. Naipaul

e) Salman Rushdie

f) Isaac Bashevis Singer

5. In the 1950s and 1960s, the "New Journalism" movement transformed journalism and ushered in a new genre known as "creative non-fiction." Which writer was NOT a part of that movement?

a) Richard Brautigan

b) Norman Mailer

c) Joseph Mitchell

d) Gay Talese

e) Tom Wolfe

6. Which of the following authors would NOT be considered part of the group of "beat" and "counterculture" writers who were popular during the 1950s and 1960s?

a) Richard Brautigan

b) Lawrence Ferlinghetti

c) Jack Kerouac

d) Ken Kesey

e) Robert Penn Warren

7. The literary style of "magical realism" involves incorporating surreal and magical elements into an otherwise realistic story. Which of the following novelists is the LEAST typical of the magical realism style?
    a) Jorge Luis Borges
    b) Gunther Grass
    c) Salman Rushdie
    d) Wallace Stegner
    e) David Foster Wallace
8. In literature, the "protagonist" of a story
    a) is the narrator of the action
    b) is the story's central character
    c) is the most likeable character in the story
    d) has an omniscient perspective on events
    e) creates obstacles for the main character
9. The phrase "There were a billion people at the concert" is an example of the literary device known as
    a) onomatopoeia
    b) allegory
    c) hyperbole
    d) oxymoron
    e) parable
10. The structural rules of a language are known as
    a) linguistics
    b) dialect
    c) grammar
    d) anaphora
    e) semantics

APPENDIX G

VOCABULARY KNOWLEDGE TEST

Instructions. This is a test of your knowledge of word meanings. Please look at the sample below. One of the five numbered words has the same meaning or nearly the same meaning as the word above the numbered words. Select your answer by clicking the number next to the word.

jovial

a) refreshing
b) 2. scare
c) 3. thickset
d) 4. wise
e) 5. jolly

The answer to the sample item is 5; therefore, you should click the number 5 next to "jolly."

Vocabulary Test Items.

1. cottontail
   a) squirrel
   b) poplar
   c) boa
   d) marshy plant
   e) rabbit
2. marketable
   a) partisan
   b) jocular
   c) marriageable
   d) salable
   e) essential

3. boggy
    a) afraid
    b) false
    c) marshy
    d) dense
    e) black
4. gruesomeness
    a) blackness
    b) falseness
    c) vindictiveness
    d) drunkenness
    e) ghastliness
5. loathing
    a) diffidence
    b) laziness
    c) abhorrence
    d) cleverness
    e) comfort
6. bantam
    a) fowl
    b) ridicule
    c) cripple
    d) vegetable
    e) ensign
7. evoke
    a) wake up
    b) surrender
    c) reconnoiter
    d) transcend
    e) call forth
8. unobtrusive
    a) unintelligent

b) epileptic
c) illogical
d) lineal
e) modest

9. terrain
    a) ice cream
    b) final test
    c) tractor
    d) area of ground
    e) weight
10. capriciousness
    a) stubbornness
    b) courage
    c) whimsicality
    d) amazement
    e) greediness
11. maelstrom
    a) slander
    b) whirlpool
    c) enmity
    d) armor
    e) majolica
12. tentative
    a) critical
    b) conclusive
    c) authentic
    d) provisional
    e) apprehensive
13. placate
    a) rehabilitate
    b) plagiarize
    c) depredate

d) apprise

e) conciliate

14. surcease

a) enlightenment

b) cessation

c) inattention

d) censor

e) substitution

15. apathetic

a) wandering

b) impassive

c) hateful

d) prophetic

e) overflowing

16. paternoster

a) paternalism

b) patricide

c) malediction

d) benediction

e) prayer

17. opalescence

a) opulence

b) senescence

c) bankruptcy

d) iridescence

e) assiduity

18. lush

a) stupid

b) luxurious

c) hazy

d) putrid

e) languishing

19. curtailment
    a) expenditure
    b) abandonment
    c) abridgment
    d) improvement
    e) forgery
20. perversity
    a) adversity
    b) perviousness
    c) travesty
    d) waywardness
    e) gentility
21. calumnious
    a) complimentary
    b) analogous
    c) slanderous
    d) tempestuous
    e) magnanimous
22. illiberality
    a) bigotry
    b) imbecility
    c) illegibility
    d) cautery
    e) immaturity
23. clabber
    a) rejoice
    b) gossip
    c) curdle
    d) crow
    e) hobble
24. sedulousness
    a) diligence

b) credulousness
c) seduction
d) perilousness
e) frankness

25. rancor
    a) forbearance
    b) ridicule
    c) malice
    d) bravery
26. raucous
    a) empty
    b) quiet
    c) smooth
    d) harsh
27. gargoyle
    a) oil
    b) medicine
    c) carved waterspout
    d) ugly building
28. recrudesce
    a) purify
    b) renew activity
    c) lack refinement
    d) crush
29. specious
    a) plausible, but not genuine
    b) noteworthy
    c) class or variety
    d) roomy
30. bauble
    a) bubble
    b) showy plaything

c) idle talk

d) confusion

31. prolific

a) scarce

b) producing abundantly

c) reckless

d) speaking profanely

32. opulent

a) party

b) wealthy

c) happy frame of mind

d) semiprecious stone

33. coercion

a) conspiracy

b) strategy

c) restraint

d) attraction

34. hiatus

a) animal

b) calamity

c) dread

d) gap

35. germane

a) microbe

b) contagious

c) relevant

d) different

36. perfunctory

a) fundamental

b) formal

c) superficial

d) careful

37. diverge
    a) reveal
    b) chant
    c) distract the attention of
    d) differ or turn off from
38. evoke
    a) take away
    b) anger
    c) connect
    d) bring out
39. pertinent
    a) relevant
    b) lying next to
    c) necessary
    d) bold
40. holocaust
    a) entirety
    b) destruction
    c) saintly
    d) price
41. piquant
    a) mellow
    b) fish
    c) pungent
    d) cloth
42. firmament
    a) foundation
    b) heavens
    c) strong
    d) glue

APPENDIX H

PERSONALITY MEASURES

Five Factor Inventory

Instructions. This questionnaire contains 60 statements. Please read each statement carefully and click on the box that corresponds to your agreement or disagreement. There are no right or wrong answers to these statements. Describe yourself honestly and state your opinions as accurately as possible.

Questionnaire Items.

_____ 1. I am not a worrier.
_____ 2. I like to have a lot of people around me.
_____ 3. I don't like to waste my time daydreaming.
_____ 4. I try to be courteous to everyone I meet.
_____ 5. I keep my belongings neat and clean.
_____ 6. I often feel inferior to others.
_____ 7. I laugh easily.
_____ 8. Once I find the right way to do something, I stick to it.
_____ 9. I often get into arguments with my family and co-workers.
_____ 10. I'm pretty good about pacing myself so as to get things done on time.
_____ 11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.
_____ 12. I don't consider myself especially "light-hearted."
_____ 13. I am intrigued by the patterns I find in art and nature.
_____ 14. Some people think I'm selfish and egotistical.
_____ 15. I am not a very methodical person.
_____ 16. I rarely feel alone or blue.
_____ 17. I really enjoy talking to people.
_____ 18. I believe letting students hear controversial speakers can only confuse and mislead them.
_____ 19. I would rather cooperate with others than compete with them.
_____ 20. I try to perform all the tasks assigned to me conscientiously.
_____ 21. I often feel tense and jittery.
_____ 22. I like to be where the action is.

_____ 23. Poetry has little or no effect on me.

_____ 24. I tend to be cynical and skeptical of others' intentions.

_____ 25. I have a clear set of goals and work toward them in an orderly fashion.

_____ 26. Sometimes I feel completely worthless.

_____ 27. I usually prefer to do things alone.

_____ 28. I often try new and foreign foods.

_____ 29. I believe most people will take advantage of you if you let them.

_____ 30. I waste a lot of time before settling down to work.

_____ 31. I rarely feel fearful or anxious.

_____ 32. I often feel as if I'm bursting with energy.

_____ 33. I seldom notice the moods or feelings that different environments produce.

_____ 34. Most people I know like me.

_____ 35. I work hard to accomplish my goals.

_____ 36. I often get angry at the way people treat me.

_____ 37. I am a cheerful, high-spirited person.

_____ 38. I believe we should look to our religious authorities for decisions on moral issues.

_____ 39. Some people think of me as cold and calculating.

_____ 40. When I make a commitment, I can always be counted on to follow through.

_____ 41. Too often, when things go wrong, I get discouraged and feel like giving up.

_____ 42. I am not a cheerful optimist.

_____ 43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.

_____ 44. I'm hard-headed and tough-minded in my attitudes

_____ 45. Sometimes I'm not as dependable or reliable as I should be.

_____ 46. I am seldom sad or depressed.

_____ 47. My life is fast-paced.

_____ 48. I have little interest in speculating on the nature of the universe or the human condition.

_____ 49. I generally try to be thoughtful and considerate.

_____ 50. I am a productive person who always gets the job done.

_____ 51. I often feel helpless and want someone else to solve my problems.

_____ 52. I am a very active person.

_____ 53. I have a lot of intellectual curiosity.

_____ 54. If I don't like people, I let them know it.

_____ 55. I never seem to be able to get organized.

_____ 56. At times I have been so ashamed I just wanted to hide.

_____ 57. I would rather go my own way than be a leader of others.

_____ 58. I often enjoy playing with theories or abstract ideas..

_____ 59. If necessary, I am willing to manipulate people to get what I want.

_____ 60. I strive for excellence in everything I do.

Creative Achievement Questionnaire

Instructions. The following questions ask about different kinds of creative accomplishments that people might have in different areas. Please click on the sentences that apply to you; you can click on more than one. For a few items, a box may pop up that asks you to "Please specify"---this means that you should type in the number of times that you have done something.

Questionnaire Items.

A. Visual Arts (painting, sculpture)

_____ 0. I have no training or recognized talent in this area. *(Skip to Music)*

_____ 1. I have taken lessons in this area.

_____ 2. People have commented on my talent in this area.

_____ 3. I have won a prize or prizes at a juried art show.

_____ 4. I have had a showing of my work in a gallery.

_____ 5. I have sold a piece of my work.

_____ 6. My work has been critiqued in local publications.

*_____ 7. My work has been critiqued in national publications. ***(Write number.)***

B. Music

_____ 0. I have no training or recognized talent in this area. *(Skip to Dance)*

_____ 1. I play one or more musical instruments proficiently.

_____ 2. I have played with a recognized orchestra or band.

_____ 3. I have composed an original piece of music.

_____ 4. My musical talent has been critiqued in a local publication.

_____ 5. My composition has been recorded.

_____ 6. Recordings of my composition have been sold publicly.

*_____ 7. My compositions have been critiqued in a national publication. ***(Write number.)***

C. Dance

_____ 0. I have no training or recognized talent in this area. *(Skip to Architecture)*

_____ 1. I have danced with a recognized dance company.
_____ 2. I have choreographed an original dance number.
_____ 3. My choreography has been performed publicly.
_____ 4. My dance abilities have been critiqued in a local publication.
_____ 5. I have choreographed dance professionally.
_____ 6. My choreography has been recognized by a local publication.
*_____ 7. My choreography has been recognized by a national publication. ***(Write number.)***

D. Architectural Design

_____ 0. I do not have training or recognized talent in this area. *(Skip to Writing)*
_____ 1. I have designed an original structure.
_____ 2. A structure designed by me has been constructed.
_____ 3. I have sold an original architectural design.
_____ 4. A structure that I have designed and sold has been built professionally.
_____ 5. My architectural design has won an award or awards.
_____ 6. My architectural design has been recognized in a local publication.
*_____ 7. My architectural design has been recognized in a national publication. ***(Write number.)***

E. Creative Writing

_____ 0. I do not have training or recognized talent in this area. *(Skip to Humor)*
_____ 1. I have written an original short work (poem or short story).
_____ 2. My work has won an award or prize.
_____ 3. I have written an original long work (epic, novel, or play).
_____ 4. I have sold my work to a publisher.
_____ 5. My work has been printed and sold publicly.
_____ 6. My work has been reviewed in local publications.
*_____ 7. My work has been reviewed in national publications. ***(Write number.)***

F. Humor

_____ 0. I do not have recognized talent in this area. *(Skip to Inventions)*
_____ 1. People have often commented on my original sense of humor.
_____ 2. I have created jokes that are now regularly repeated by others.
_____ 3. I have written jokes for other people.
_____ 4. I have written a joke or cartoon that has been published.
_____ 5. I have worked as a professional comedian.
_____ 6. I have worked as a professional comedy writer.
_____ 7. My humor has been recognized in a national publication.

G. Inventions

_____ 0. I do not have recognized talent in this area. *(Skip to Scientific Discovery)*
_____ 1. I regularly find novel uses for household objects.

_____ 2. I have sketched out an invention and worked on its design flaws.

_____ 3. I have created original software for a computer.

_____ 4. I have built a prototype of one of my designed inventions.

_____ 5. I have sold one of my inventions to people I know.

*_____ 6. I have received a patent for one of my inventions. ***(Write number.)***

*_____ 7. I have sold one of my inventions to a manufacturing firm. ***(Write number.)***

H. Scientific Discovery

_____ 0. I do not have training or recognized ability in this field. *(Skip to Theater)*

_____ 1. I often think about ways that scientific problems could be solved.

_____ 2. I have won a prize at a science fair or other local competition.

_____ 3. I have received a scholarship based on my work in science or medicine.

_____ 4. I have been author or coauthor of a study published in a scientific journal.

*_____ 5. I have won a national prize in the field of science or medicine. ***(Write number.)***

*_____ 6. I have received a grant to pursue my work in science or medicine. ***(Write number.)***

_____ 7. My work has been cited by other scientists in national publications.

I. Theater and Film

_____ 0. I do not have training or recognized ability in this field. *(Skip to Culinary Arts)*

_____ 1. I have performed in theater or film.

_____ 2. My acting abilities have been recognized in a local publication.

_____ 3. I have directed or produced a theater or film production.

_____ 4. I have won an award or prize for acting in theater or film.

_____ 5. I have been paid to act in theater or film.

_____ 6. I have been paid to direct a theater or film production.

*_____ 7. My theatrical work has been recognized in a national publication. ***(Write number.)***

J. Culinary Arts

_____ 0. I do not have training or experience in this field.

_____ 1. I often experiment with recipes.

_____ 2. My recipes have been published in a local cookbook.

_____ 3. My recipes have been used in restaurants or other public venues.

_____ 4. I have been asked to prepare food for celebrities or dignitaries.

_____ 5. My recipes have won a prize or award.

_____ 6. I have received a degree in culinary arts.

*_____ 7. My recipes have been published nationally. ***(Write number.)***